

Space Weather Technical Forecast

Issued on Sunday 29 September 2024 at 13:14 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-flares (R1-R2 Blackouts).**Analysis of Space Weather Activity over past 24 hours**

Solar Activity: Activity is Low with a couple of long-period C-flares, the largest of which is currently ongoing, possibly originating from over the northeastern limb. There are nine sunspot regions visible, with the most complex of these being AR3842 in an area of plage near the southeast limb. This has a small delta spot to the south of its main negative leader. AR3835 and also AR3834 have shown some growth, and are both located in the southwest quadrant, but remain relatively simple bipolar spots. AR3836, located in the south-centre disc, is an unusual region, consisting of a large number of spots of one polarity, but very few opposite polarity ones. However this also remains relatively inactive. Spot regions elsewhere on the disc are currently fairly small and stable.

A CME was observed off the southwest limb in association with one of the long-period C-flares mentioned above, with analysis underway to determine any Earth-directed component.

Solar Wind / Geomagnetic Activity: Waning effects of a glancing CME on 28 Sep continue, with solar winds at background, varying between 300-350km/s. Density was initially below average but rose to average with the CME. Interplanetary Magnetic Field, Bt, was mostly weak, with some Moderate intervals from 29/0350UTC onwards, varying between 2-11nT. The north-south component was generally fairly variable, but did have some extended negative (southward) intervals, varying between -8 and +6nT. Phi angle was predominately positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels for much of the period, but with a period of Moderate 28/0835-2025 UTC, peaking 468 pfu at 28/1605 UTC. The associated 24-hour fluence was below the Active threshold. The 29/0000 UTC observation was 9.26e6 integrated pfu.

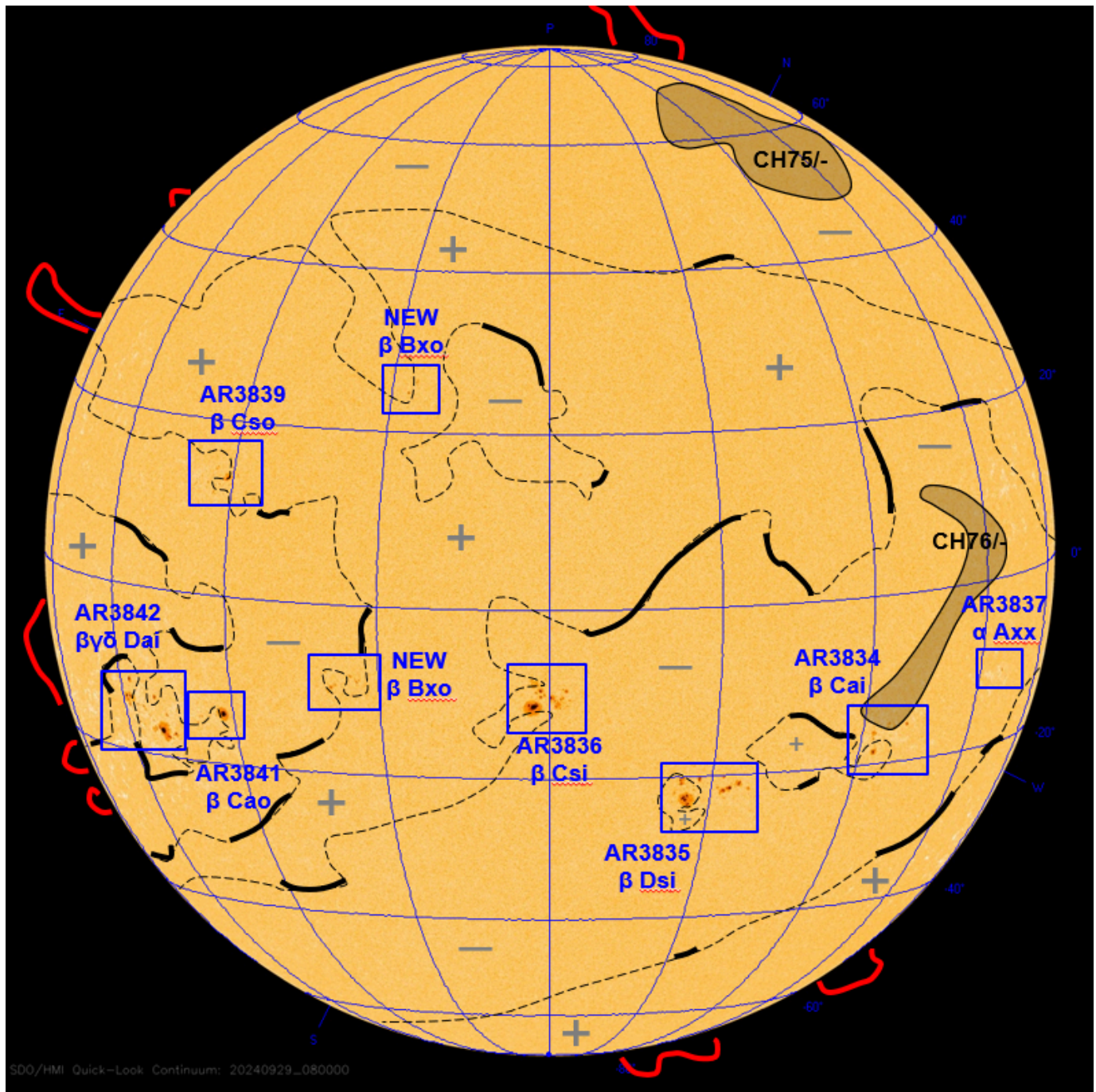
Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of further isolated M-class flares. There is a very slight chance of an isolated X-class flare from AR3842.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs in the forecast. Background solar winds are expected until a possible weak enhancement occurs, from the fast wind of CH76/-, with wind speeds perhaps reaching around 450km/s, most likely days 1-2 (29-30 Sep), before easing back to background slow wind conditions. Mainly Quiet (Kp 0-2) geomagnetic conditions are expected, but with a spell of Unsettled to Active (Kp 3-4) possible from any fast wind onset days 1-2 (29-30 Sep).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background, High energy electron flux at GOES16 is currently ranging between Background and Moderate. A drop out in values is possible with the onset of any fast wind enhancement days 1-2 (29-30 Sep), before a possible recovery to Background to Moderate later in the period. The associated 24 hour fluence is expected to remain below the Active threshold (1e8 total pfu).

Figure 1: Solar Synoptic Map valid 29/0800 UTC



Key: Filament __, Prominence __, Magnetic Field Line ---, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms

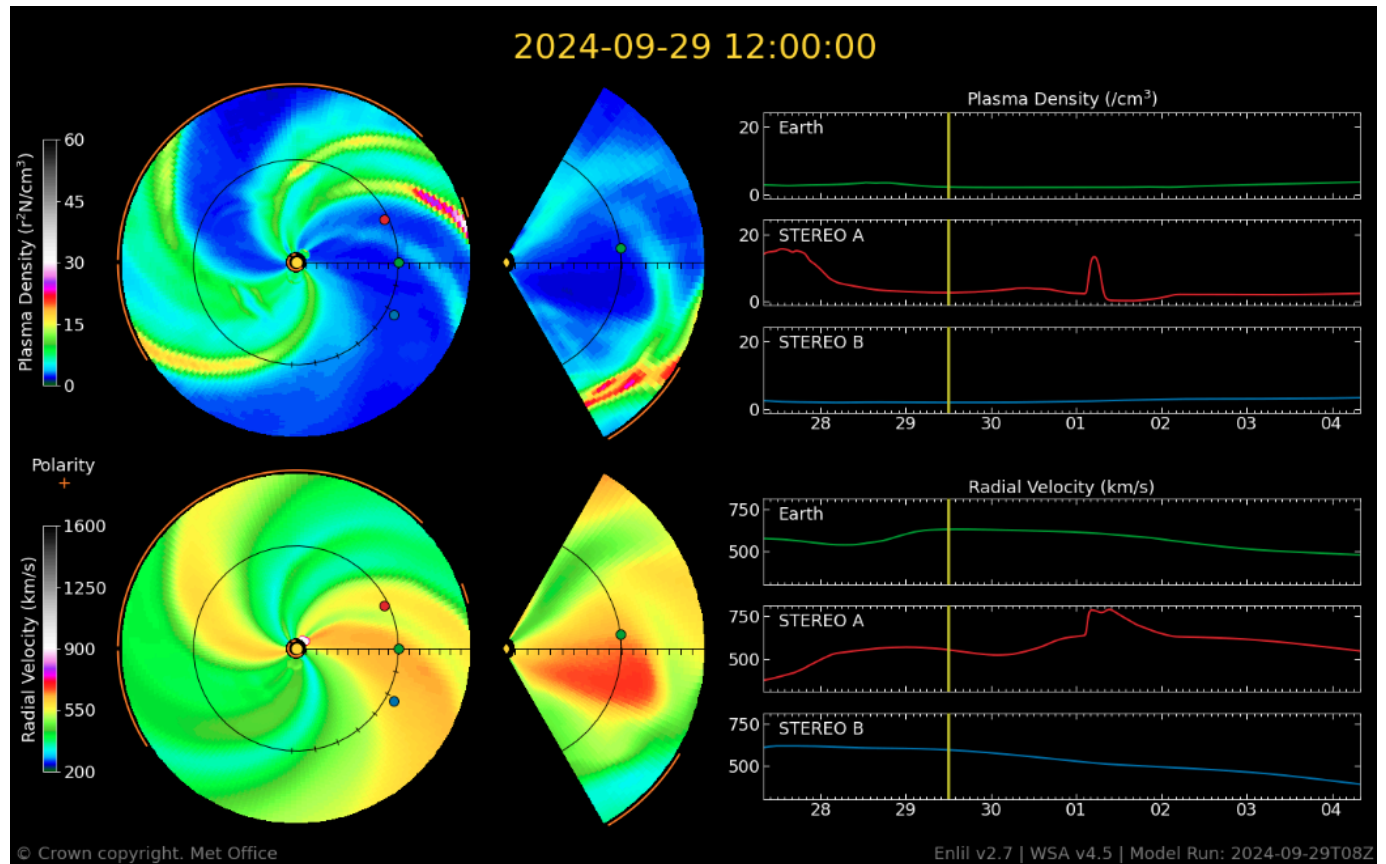
There are no Earth-directed CMEs in the forecast. A CME was observed coming off the southwest limb in association with a long-period C5 flare, with analysis underway to determine any Earth-directed component. A second CME was observed from over the northeast limb, although this is deemed to be far-sided. There are a number of filaments currently on the Earth-facing disc, which brings a slightly increased chance of CMEs being produced over the coming days.

Solar winds are currently at background, with the next potential enhancement from the onset of any fast wind from CH76/-, most likely to occur days 1-2 (29-30 Sep). However, confidence is low for the timing and strength of any onset due to this feature being an unfavourable polarity for a strong connection at this time of year, and also due its narrow appearance. MOSWOC Enlil is also providing little useful guidance due to it instead modelling a swathe of fast winds that has not been observed and has no clear source. A very weak, and relatively brief connection is most likely, with solar winds rising to around 450km/s for a time, before easing.

Overall, mainly Quiet Geomagnetic activity is expected with a chance of isolated Unsettled intervals. However any fast wind enhancement will bring the likelihood of an Unsettled to Active spell, most likely day 1 or day 2 (29-30 Sep). Confidence becomes lower by day four (02 Oct) due to the number of filaments currently on the disc, as any disruption could result in an Earth-directed CME, and a subsequent increase in geomagnetic activity towards the end of the period.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	5	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil model. Note that Enlil currently has Earth in a broad and fast high speed stream, which isn't the case in reality.



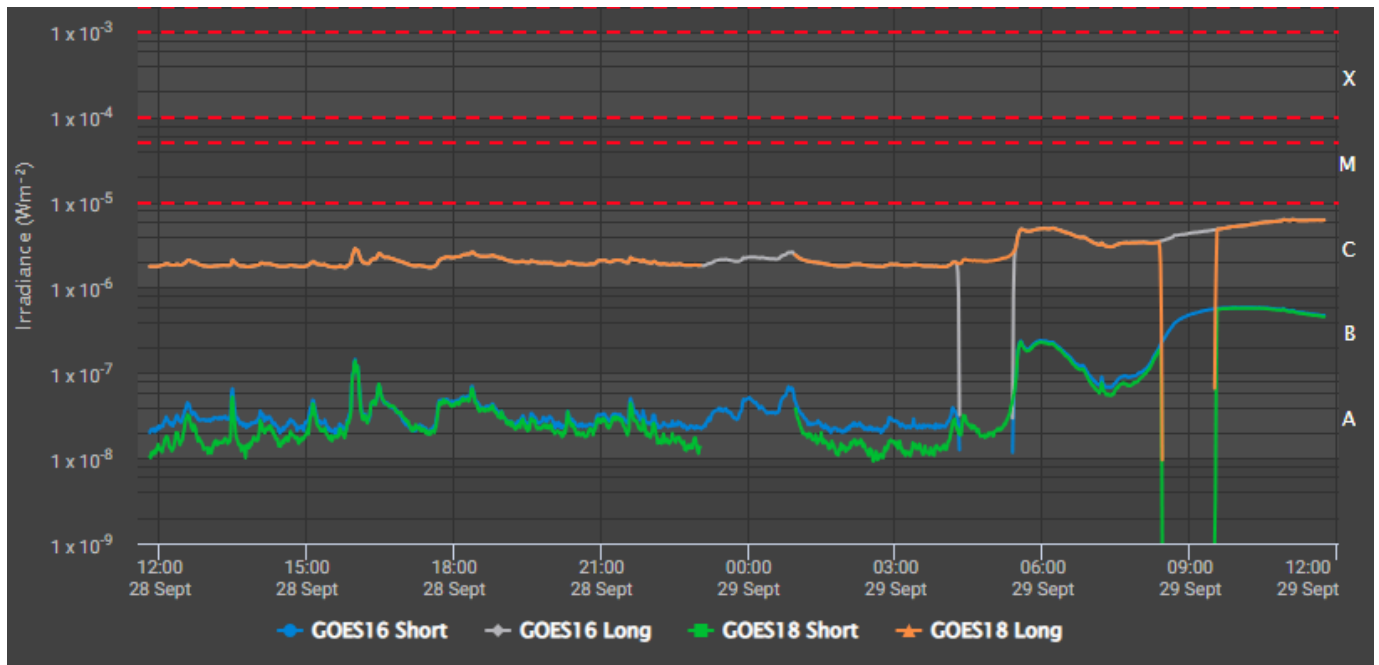
Radio Blackouts - X-Ray Flares

Low to Moderate activity is forecast with an ongoing chance of isolated M-class flares. There is a slight chance of X-class flares

There are nine visible sunspot regions. The most notable is AR3842 on the southeast disc, which is now moving into a less oblique viewing angle. This is a relatively small and ragged looking region, but set amongst a broad area of plage with a small delta spot on the the southern edge of its negative leader, and also appears bright on SDO aia-94 imagery. Further details are also likely to be apparent as it moves into a clearer view, along with some ongoing growth possible. This region is the most likely source of any larger or more significant flares.

Thee other regions are generally simpler, but include a few of note. AR3836 in the south-centre is an unusual region, consisting of a number of spots, but nearly all of a single negative polarity besides two small positive spots, one on its northern periphery and the other trailing in the east. AR3835 and AR3834, both on the southwest disc, remain relatively simple bipolar regions and are showing signs of maturing with some of their smaller spots coalescing into larger ones. Some slight development has also been observed in AR3841 with some small peripheral spot emergence.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

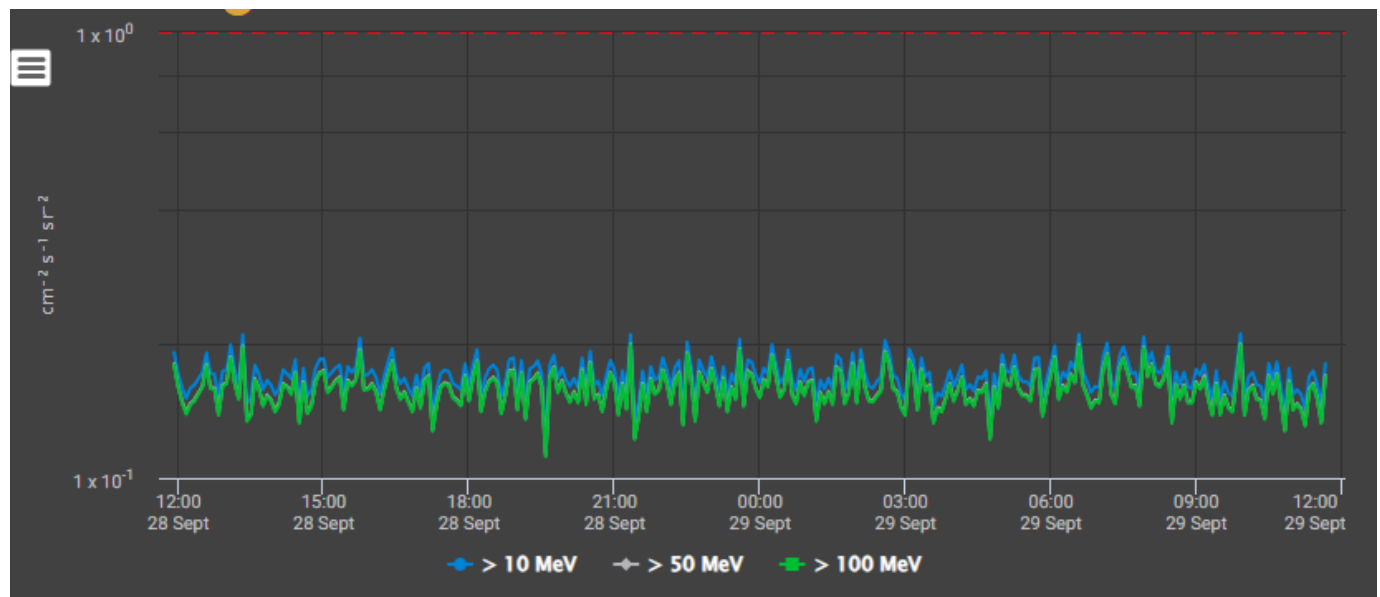
Figure 3: GOES-16 & -18 X-ray flux

Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is forecast to persist at background levels. The current visible sunspots are generally small and simple providing only modest contributions to flare risk, and are unlikely to significantly impact proton flux at Earth. However, given the number of notable filaments currently on the disc, there is also a very low, albeit non-zero chance of observable protons should any significant filament eruption occur during the period.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq S1$	No	5	5	5	5
Very Active	$\geq S3$ *	No	1	1	1	1
* $S3 \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and/or $50 \text{ MeV} \geq 10 \text{ pfu}$. ($\text{pfu} = \text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

Figure 4: GOES-18 Proton flux



High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux observed by GOES16 became Moderate for a time on 28 Sep, likely as a consequence of the previous fast wind enhancement on 25 Sep, and easing solar winds. Background to Moderate levels are expected to persist at first, although a more definitive drop out is likely later day 1 or day 2 (29-30 Sep) due to any fast wind that occurs from CH76/-. This is likely to be a relatively brief and weak enhancement, with electrons perhaps recovering to give periods of Moderate day 3-4 (01-02 Oct)

The associated 24 hour fluence is forecast to stay below Active ($1\text{e}8$ total pfu), in agreement with MOSWOC REFM, although this is currently underestimating observed values.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: GOES-16 Electron flux

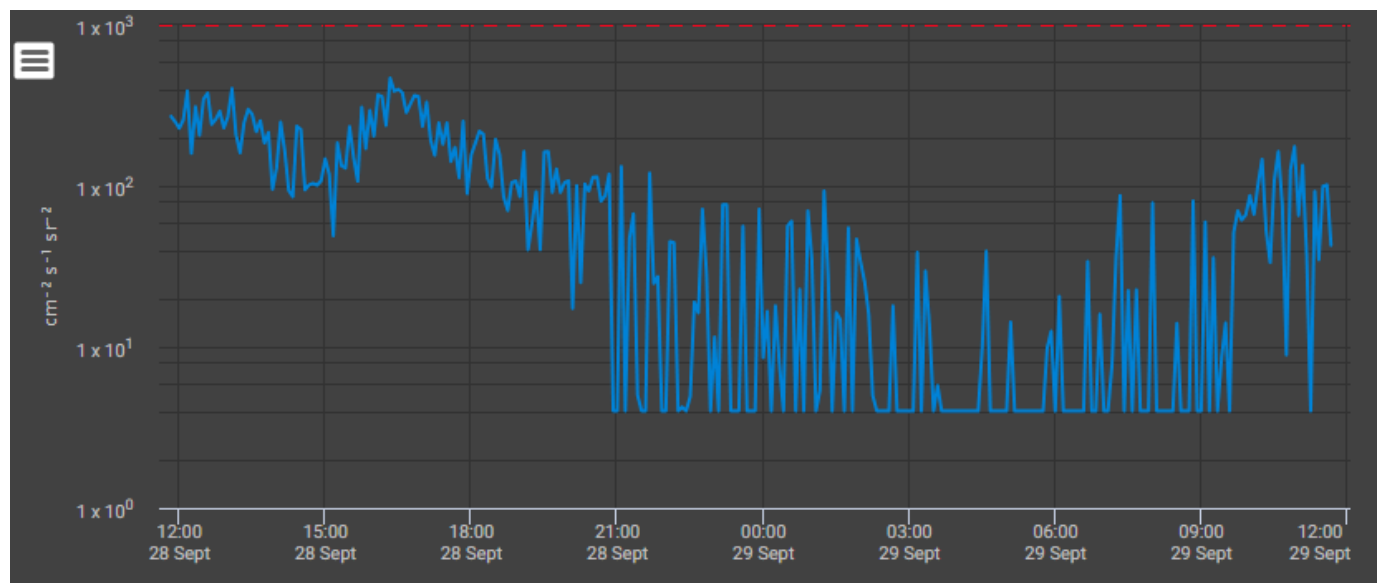


Figure 6: MOSWOC REFM